LABORATORY
pH / ION METER
CPI-501
CPI-502

USER'S MANUAL

ELMETRON

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pH – ION METER
CPI-501, CPI-502

Before use please read the instruction carefully!

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I. INTRODUCTION

1. EXPLOITATION NOTICES

Dear User!
We present you a device distinguished by accuracy according to the technical data and by a high stability of the displayed results. We believe that the measurements will not cause you any trouble and that the meter will operate without any inconvenience. **Wide range of additional functions requires careful reading of the manual in other case some of the features may stay unused or using the meter may cause you a troubles.**
The employing of good-quality electrodes cells and probes and their replacing after a suitable time ensures obtaining of high measuring parameters. We want to call your attention to the fact, that this equipment has a much shorter working life than the meter. Typical symptoms of an improper operation of the electrode are deterioration of final result stability, it's flowing as well as a higher measuring error. **Part of the users has problems, arising from employing electrodes not being preconditioned before the measurement or making the measurements without removing the shielding ring from the liquid junction or taking measurements with a plugged junction.** To avoid this situation it is necessary to choose the proper kind of electrode for solutions which are going to be measured ex. special electrodes for the sewage, liquids with deposits, meat cheese etc. Therefore, if you observe improper operation of the device, please take control measurements with another electrode or check the used electrode with another pH-meter. **Generally the deterioration of the meter work is caused by the electrode and not by the meter.**
The essential feature of our products is their low failure frequency. However if your pH-meter will fail, our firm immediately performs its warranty repair.

During ion selective measurements a very often case is worsening of the results stability, this is connected only with the quality of the ion selective electrodes.

We wish you a pleasant and trouble-free work with our meter.

2. THE CHARACTERISTICS OF THE METER

The pH / ion meters **CPI-501** and **CPI-502** belong to the newest generation of measuring devices which offer wide range of additional functions. Technical data, extra features and way of maintenance are identical in both models. The **CPI-502** has additionally build in thermal printer which enables printing the actual and stored in the memory results.
The meters ensures high accuracy and repeatability of the readings. The newest generation electronic elements used in the meter made it's memory independent to power supply. The internal clock is powered from battery which is enough for many years. The meter is equipped with custom LCD display, which enables simultaneous observing of the measured function, temperature value and additional symbols which make working easier. Waterproof housing makes working in difficult conditions possible.
Main features of the **CPI-501** and **CPI-502** are:

- high accuracy and stability of the reading;
- measurement of pH, ions, mV and temperature;
- automatic and manual temperature compensation;
- electrode calibration in 1 to 5 points;
- automatic recognition of pH buffers and standards;
- imposed values of standard solutions with possibility of changing their value;
- option of automatic introduction of temperature correction on the value of pH buffer solutions (NIST norm);
- information about the condition of the pH electrode;
- independent storing of three characteristics of pH and Ion selective electrodes;
- in ion meter measurements in pX, g/l, M/l or ppm;
- in the ion meter possibility of introducing a freely chosen values of the sample solutions;
- internal datalogger for 200 (optionally 450 or 950) measurements with time date and temperature;
- taking series of measurements with set time interval;
- RS-232 output
- possibility of printing the measurement results or values stored in the memory on standard printer ;
- real clock and date.

3. WHAT IS THE METER DESIGNED FOR

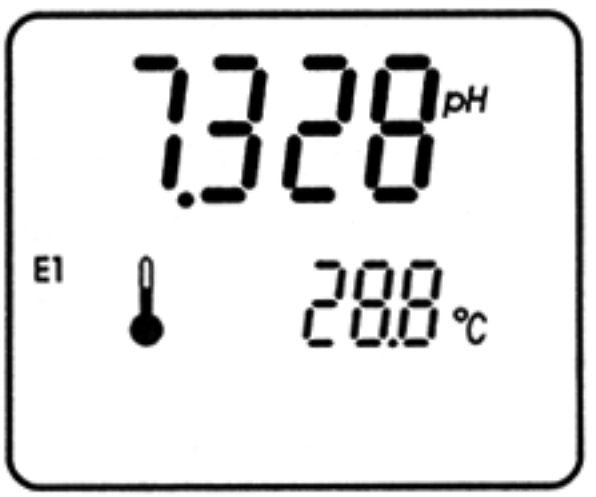
The pH / ion meters **CPI-501** and **CPI-502** are precise and easy to use meters designed for hydrogen ion concentration measurements in pH units, ion selective measurements in pX, g/l, M/l or ppm and Oxidation Reduction Potential (mV). There is possibility of measurements of monovalent and bivalent ions, positive and negative. Measurement of the chosen ion is connected with using a combination ion selective electrode (ISE) or measuring and reference electrode.
The meters may be also used for accurate temperature measurement of solutions and air in °C.
The meters are being used in food, chemical, pharmaceutical, energetical industries, in water treatment stations, laboratories, agriculture, universities, scientific laboratories etc.
CPI-501 and **CPI-502** are prepared to work with all types of combination pH electrodes and ion selective electrodes equipped with BNC-50 connector. There is also possibility of using a separate measuring and reference electrode. The meters co-operate with Pt-1000 temperature probe with Chinch connector.
The meter may collect measurements taken as single or series of measurements with set time interval. Built in RS-232 interface enables connecting the meter wit a PC for sending the data. Centronics output enables connecting the meter with a standard printer. There is possibility of printing the data collected in the memory or current results of the measurement.
CPI-502 enables printouts with use of the built in thermal printer (60 mm width).
In case of necessity to collect series longer than the memory capacity results it is possible to use special PC software offered by our company.

4. . OUTSIDE VIEW

On the left side of the meter there is a LCD display (pic. 1) on which depending on the chosen function following symbols are displayed:

- result of the pH measurement in pH units;
- result of ion measurements in pX, g/l, M/l or ppm;
- result of the mV measurement in mV;
- time and date.

Choosing the function is done by specific buttons and is signalised by lighting LED diode placed on the button.
Simultaneously with the result a measured temperature value is displayed in ^{o}C. Symbols of the units are displayed by the results.



Pic. 1.

Beside the temperature value a symbol for automatic temperature compensation is displayed or for manual. ***CAL*** symbol on the left side of the display informs that the meter is in calibration mode.
On the left side of the display a number of chosen electrode is showed (E1; E2; E3) which inform about the number of characteristic which will be taken into consideration during all calculations. On the right side of the display a battery symbol which informs about the battery condition is displayed. During calibration between the upper and lower row of numbers number of the calibration point is displayed (P1, P2, P3, P4, P5).
In the MODE all parameters introduced by the user are displayed and also the value of atmospheric pressure measurement (in oxygen measurement function). The keyboard (pic. 2) placed under the display is used for switching the meter on and off, choosing the measuring function, calibration, entering the parameters, printing and storing the results in the memory.

The keyboard has the following keys:

ON/OFF - switches the meter on and off;

pH - chooses the pH measuring function;

mV - chooses the mV measuring function;

Ion - chooses the Ion measuring function;

time - displays the time and date;

CAL - longer pressing of this button enters the calibration mode (*CAL* symbol displayed). Short pressing in this mode confirms the calibration result;

MEM/PRINT - short pressing causes storing or printing of single result or measuring series, longer pressing enters the stored results readout mode.

MODE - chooses the entered parameter;

◄ , ► - buttons for entering the parameters.

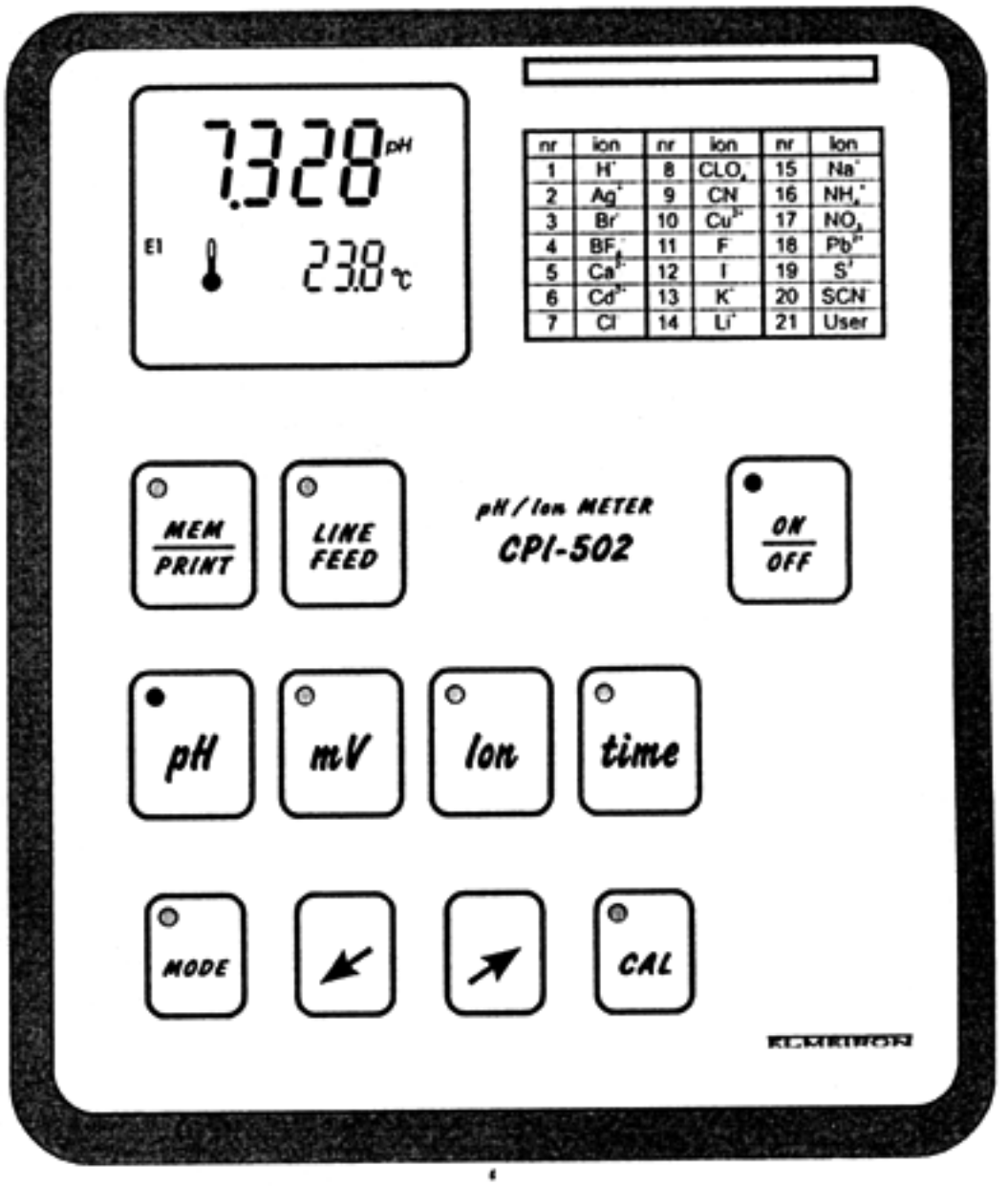
LINE FEED - enables pulling out and slipping in of the paper by the printer (only in **CPI-502**).

Next to the display a table of the ions stored in the meters memory is placed. Their molecular weight is automatically taken to all unit calculations.

On the back wall of the meter there are inputs with below given symbols:

pH/mV - **BNC-50** connector for connecting combined or measuring pH electrode and ORP or ion selective electrodes;
Gnd - connector for reference electrode;
temp - **Chinch** connector for temperature probe;
POWER - connector for power adapter.

On the right side of the meter there are RS-232 and Centronics outputs.


7.328 pH
E1
23.8 °C
nr | ion | nr | ion | nr | ion
1 | H+ | 8 | ClO4- | 15 | Na+
2 | Ag+ | 9 | CN- | 16 | NH4+
3 | Br- | 10 | Cu2+ | 17 | NO3-
4 | BF4- | 11 | F- | 18 | Pb2+
5 | Ca2+ | 12 | I- | 19 | S2-
6 | Cd2+ | 13 | K+ | 20 | SCN-
7 | Cl- | 14 | Li+ | 21 | User
MEM PRINT
LINE FEED
pH / Ion METER
CPI-502
ON OFF
pH
mV
Ion
time
MODE
CAL
ELMETRON

Pic. 2.

5. SWITCHING THE METER ON AND OFF

The meter is switched on by pressing the [ON/OFF] button. The meter tests the memory and display on which all symbols are displayed (pic.3).

Pic. 3.

If the test was successful, after about 1.5 s the meter switches it self automatically to the measuring mode, in which it was switched off. If an HELP sign will be displayed it means that the meter has lost the factory settings and requires the service repair. If after the 1,5 s all symbols will be continuously displayed it informs that the calibration parameters of electrodes or cells were lost.

After pressing the [CAL] button the meter will take standard characteristics:
- shift = 0 pH, characteristic slope = 100% for pH electrode;

And will enter the measuring mode. It will be necessary to calibrate the conductivity cell and pH electrodes.

The meter is switched off by pressing and longer holding of the [ON/OFF] button

6. PREPARATION TO WORK

Before starting the work one should:
- join the power adapter plug to the **Power** input;
- to **pH/mV** input (BNC-50) join the ready to work combination pH electrode, ion selective electrode or redox electrode;
- in case of using the temperature probe it should be connected with the chinch temperature input - **temp**;
- In case of work with PC join the 5XX-PC cable with **RS-232** input
- In case of printing results on the printer connect the printer cable with **Centronics** output.
- switch the meter on by pressing the ON/OFF button.

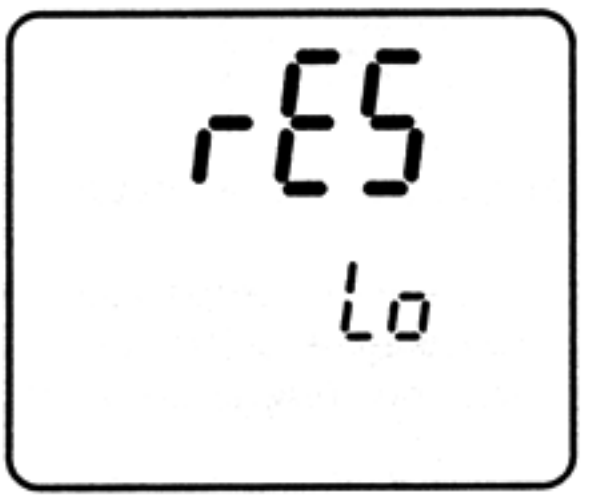
6.1. Choosing the kind of temperature compensation

The meter switches it self to the automatic temperature compensation mode automatically after joining the temperature probe, after disconnecting it the meter enters the manual temperature compensation mode. In ATC mode near the displayed temperature a symbol appears. Manual temperature compensation is indicated by symbol near the value entered by the user, it's value may be changed using ↙ or ↗ keys.

6.2 Changing the resolution of the measurements

The measurement results may be displayed with chosen resolution. To change it one should:

- in the measuring mode press the MODE button, a rES (resolution) sign will be displayed. (Pic. 4)
- Using keys ◄ or ► one may choose:
  Lo - (low) resolution of the measurement;
  Hi - (high) resolution of the measurement.



Pic. 4

For the pH measurement:
Lo - resolution of the measurement 0.01 pH;
Hi - resolution of the measurement 0.001 pH.

In the ion meter function:
for measurement in pX:
Lo - resolution of the measurement 0.01 pX;
Hi - resolution of the measurement 0.001 pX.

For measurement in M/l, g/l and ppm:
Lo - resolution of the measurement 0.1%;
Hi - resolution of the measurement 0.01 %.

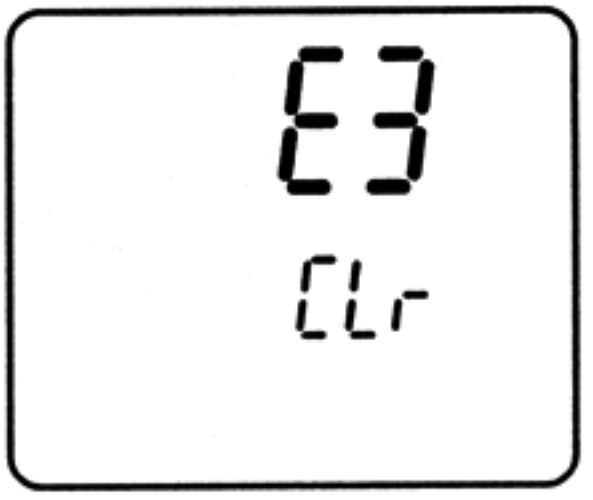
Return to the measuring mode by pressing the chosen function button

6.3. Changing the electrode number

If in the meter's memory more than one electrode characteristic was stored, it is possible to replace the electrodes without the need of calibration. This option is quite useful in case of using different kinds of electrodes ex. for sewage, and clear water etc. It is necessary to connect the earlier calibrated electrode, marked with the number which responds to the number which was stored in the memory and choose this number.
To do so in the pH or ion measuring mode:

Press the MODE button, than using ↙ or ↗ buttons choose the electrode number (symbols E1, E2, E3) under this number the calibration results will be stored (pic. 5). Above the electrode number following signs will be displayed:

- CLr - under this number there is no characteristic stored and producers values are provided.
- SEt - under this number there are values of last calibration stored.
- bAd - the last calibration showed that the electrode is loosing it's efficiency and in short time it's calibration won't be possible. (only for electrode calibrated in pH function)



Pic. 5.

In the ion meter function during changing the electrode number it is possible to check the ion number for which the electrode was calibrated. It is done by short pressing the CAL button, in the lower row a ion symbol will be displayed and in the upper row it's number. After pressing the CAL button the meter returns to electrode choosing. Pressing of any function button returns the meter to measuring mode.

II. pH measurement

7. PREPARATION OF THE pH ELECTRODE

The electrode should be prepared to work according to the producer instructions. If the instructions weren't given please follow the steps:

- new electrode should be put into distilled water or in saturated KCl solution for about 5 hours:
- Before starting the measurements protecting rings (if used in this kind of electrode) should be removed. The ring placed on the junction – lower part of the electrode should be moved up along the electrode's body and the upper, which protects the KCl refilling hole, down along the body.
  Removing the lower ring is essential, in other case the electrode won't measure.
  Upper ring should be removed during measurements of high temperature solutions or to protect the junction during measurements in solutions with deposits or oils. Sometimes instead of ring a cork is used;
- during measurements in laboratory it is advisable to use an electrode holder;
- after every measurement the electrode should be washed in distilled water;
- excess of liquid on the electrode should be removed by gentle touching the glass with a tissue paper;
- after work the electrode should be stored in one of the above given solutions. The protecting rings should be moved on the junction and upper hole;
- in case of long breaks between the measurements the electrode should be stored, after drying, in the packaging;
- after taking the electrode of the package the eventual deposit should be removed using water;
- before using the electrode it should be placed in distilled water for about 2 hours;
- if the construction of the electrode enables refilling the electrolyte, it should be controlled and refilled periodically by the upper hole in the electrode's body (usually as the electrolyte a KCl solution is used).

CAUTION: storing of the electrode in distilled water shortens it's life time and may cause shifting of the zero point.

8. CALIBRATION OF THE pH ELECTRODE

Before starting the measurement with new electrode, after long-lasting using, or before making measurements which require higher accuracy the electrode connected with the meter should be calibrated. Results of measurements done without calibration will have a great error. The calibration is done on the buffer or sample solutions. It depends on comparing pH value of the buffer solutions with the value displayed by the meter and next automatic introduction of correction which is taken into consideration during measurements. The calibration should be periodically repeated because during work the parameters of the electrode are changing what influences the accuracy. The frequency of this procedure depends on the demanded accuracy, number of the measurements carried out, conditions in which the electrode was used, temperature and value of the measured solutions. When the highest accuracy is required it is recommended to use sample solutions with certificates. In technical usage buffer solutions are used with lower accuracy but mostly with total values ex. 2.00 pH; 4.00 pH etc. In this manual to make it easier a buffer solution name was used for both buffer and sample solutions. For accurate measurements it is necessary to use fresh good quality buffers.

The first action taken before the calibration is entering the values of used pH buffer solutions to the meters memory. This should be done before the first calibration and repeated in case of changing the used buffers to other values.

During the calibration after immersing the pH electrode and temperature probe the meter automatically detects the value of the used buffer, if it was earlier stored in the meter's memory.

There is possibility of calibration in minimum 1 buffer solution and maximum in 5. The more points of calibration is used the higher is the accuracy in the whole measuring range.

Calibration in one buffer solution can't ensure high accuracy. If only one buffer solution is used it's value should be close to the forecasted value of measured solution. If the required accuracy isn't very high and the measurements will be done in the whole range the one point calibration should be done with buffer solution close to 7.00 pH. Thanks this the so called zero electrode shift will be eliminated. In other points a standard characteristic will be taken from the meter's memory.

This characteristic corresponds with theoretical efficiency of the pH electrode. If measurements are done both in acids and alkalis and the measurements are not done at the ends of measuring range it is enough to calibrate the electrodes in 3 buffer solutions with values in range given in table 2 – calibration points 2, 3 and 4. In case of accurate measurements in the whole range it is recommended to calibrate the electrode in all 5 points given in the table. In **CPI-501** and **CPI-502** characteristic of the electrodes is approximated linearly between the calibration points.

Starting the calibration under one of the electrode numbers does not remove the set buffer values, but irreparably removes the electrode characteristic stored under this number.

There is no possibility of calibrating only one point and leaving the rest of data from the last calibration.

Memory in **CPI-501** and **CPI-502** enables independent storing of 3 characteristics of pH electrodes. This feature is especially useful when fast replacing of the electrodes is necessary or when it was broken. Those electrodes should be earlier calibrated and brought into memory under following symbols E1, E2, E3.

The order of using the buffer solutions is freely chosen.

8.1. Calibration modes

The user may choose two independent ways of action:

1. use the values of pH sample solutions entered to the memory by the manufacturer. Those values are in conformity with the NIST norm. This type of calibration switches on the automatic correction introduction connected with the change of sample solution along with temperature changes.
2. enter the value of pH buffer solutions depending on the actually used buffers, in the range given for each point of calibration;

Choosing the first option makes the calibration much easier. The user doesn't need to warm up or cool down the sample solutions to the temperature given by the user. This option includes some simplifications and when very high accuracy is required it shouldn't be used. The meter stores independently 5 values of the buffers for each of the calibration modes described above.

8.2. Calibration with use of NIST sample solutions

In this mode 5 constant sample solutions values, according to NIST, are used. **In the meters memory a table with dependence between the temperature and pH values for this 5 sample solutions is stored.** This dependence is showed in the table 1. During the calibration the temperature of sample solution is measured and on it's basis automatically the right pH value responding to this temperature is taken into consideration. Values between the points given in the table are approximated linearly by the meter.
The highest accuracy may be obtained only when the pH values of the buffer solutions are identical as in the table.
If there are some differences between the values given in the table and values given by the producer of buffer solutions, one should judge weather the error which will occur during calibration with automatic correction of the value won't be to big. If yes one should resign from using this option.
Some sample solutions made according to the appropriate norms may differ on the third decimal place. In case of accurate measurements the user may not use the mode with use of NIST sample solutions but the mode which enables setting the buffers value and before the calibration set, in the meter's memory, the accurate value of the used sample solution according to pt. 8.2.
The range of the temperatures, taken into consideration during introducing the correction, is 0 to 60 ^{o}C and can't be exceeded.

The way of action during calibration way choice and entering sample solutions values other than those in table 1 was described in chapters 8.2. and 8.3.

Table 3.

Temp. °C	Kind of buffer solution				
	1 oxalate	2 phthalate	3 phosphate	4 di-sodium tetraborate	5 calcium hydroxide
0	1.666	4.003	6.984	9.464	13.423
5	1.668	3.999	6.951	9.395	13.207
10	1.670	3.998	6.923	9.332	13.003
15	1.672	3.999	6.900	9.276	12.810
20	**1.675**	**4.002**	**6.881**	**9.225**	**12.627**
25	1.679	4.008	6.865	9.180	12.454
30	1.683	4.015	6.853	9.139	12.289
35	1.688	4.024	6.844	9.102	12.133
40	1.694	4.030	6.838	9.063	11.984
45	1.700	4.047	6.834	9.038	11.841
50	1.707	4.060	6.833	9.011	11.705
55	1.715	4.075	6.834	8.985	11.574
60	1.723	4.091	6.836	8.962	11.449

8.3. Introducing the pH values of buffer solutions.

Values of the pH buffer solutions set by the producer in the meter's memory are given in the table 2. If the values of used buffer solutions are different than the given above the user should change the set values to the actually used.

Table 2.

Point of Calibration	Resolution 0,001	Resolution 0,01
1	2,000	2,00
2	4,000	4,00
3	7,000	7,00
4	9,000	9,00
5	12,000	12,00

The range of possible changes is limited for each calibration point.
The meter doesn't allow for introducing pH values in ranges other than those given in the table 3.

There is possibility to introduce the values of buffer solutions with two or three decimal places, depending on the chosen resolution.

Table 3.

Calibration point	Range
1	0,800 ÷ 2,100
2	3,900 ÷ 4,100
3	6,800 ÷ 7,100
4	8,900 ÷ 10,200
5	11,800÷ 14,000

The values of pH buffer solutions entered by the user are stored in the meter's memory till their changing to others. Introducing of the sample solutions values should be repeated in case of using buffers with values different than those set in the meter's memory.
The range of introducing the pH values of the buffer solutions in the individual points of calibration is quite wide what enables to use buffer solutions with values which differ from those set by the producer. For example buffers with value 2,00 pH; 7,00 pH; 9,00 pH; and 12,00 pH may be used. In every case the introduced buffer solution will be automatically recognised by the meter.
Together with the temperature change value of the pH buffer solution changes. The producers often give the values of the solutions in few temperatures. This data may be used and the meter may be calibrated in other temperature than 20 ^{o}C, by introducing to the meters memory value of the buffer which responds to this temperature

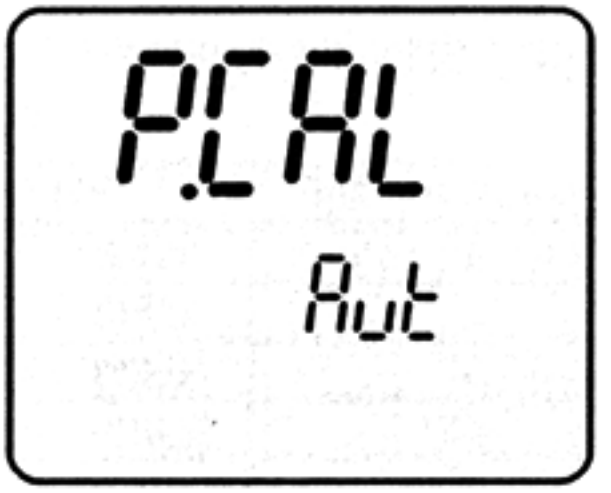
8.4. Entering the calibration parameters

It is necessary to:

a. Choose or block the function of automatic correction of the change of pH value of buffer solution with the temperature. (as described in chapter 8.2)

   To do so one should press the MODE button than a PCAL symbol (points of calibration) will be displayed, (pic. 6) next using ◄ or ► buttons choose:

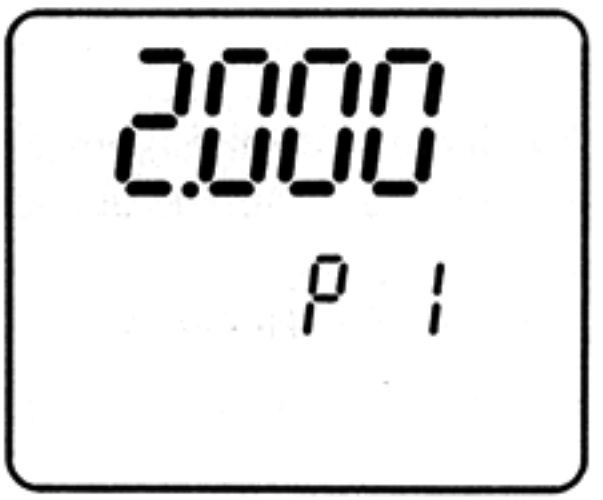
   Aut – automatic change of the stored pH value of the buffer solution by it's temperature change according to table 3.
   USt – setting the value of the buffer solution in the range given in table 3.



Pic. 6.

After choosing the AUt symbol one should press the [pH] button and start the calibration in buffer solutions according to chapter 8.5.
After choosing the USt act according to the point **b**.

b. After choosing the USt (user setting) symbol one should start checking and eventually changing the stored values of calibration points. To do so one should press the [CAL] button. In the lower row a P1 symbol will be displayed, point one of calibration, and in the upper row value of the buffer. (pic. 7) If one uses buffer solution with value a bit different than this displayed one, using [↙] or [↗] buttons bring the displayed value to the value of used buffer solution.
Range of changes for each calibration points is given in the table 3.



Pic. 7.

To pass to the second point of calibration press the [CAL] button in the lower row a P2, symbol will be displayed (point 2) and in the upper row the stored in this point value of buffer solution. When checking or changing the value in the next steps please follow the instructions given above.
After the end of introducing the pH values of buffer solutions using the [MODE] button return to the choosing the calibration points mode (Aut / USt,) or by pressing the [pH] enter the pH measuring mode and calibration, chapter 8.5.
During next calibrations if the values of the previously used buffer solutions haven't changed the actions described in this point may be omitted.

8.5. pH electrode calibration

It is necessary to:

a. choose the resolution with which the pH sample solution value will be introduced, point 6.2.

b. choose the electrode number under which the results of calibration will be stored, point 6.3.

c. prepare the electrode to work according to the producer's instructions and mark it with number responding to number chosen in the meter (E 1, E2, E3).

d. connect with the meter the prepared combination pH electrode and temperature probe, use the right connectors **pH/mV/Ion** and **temp**;

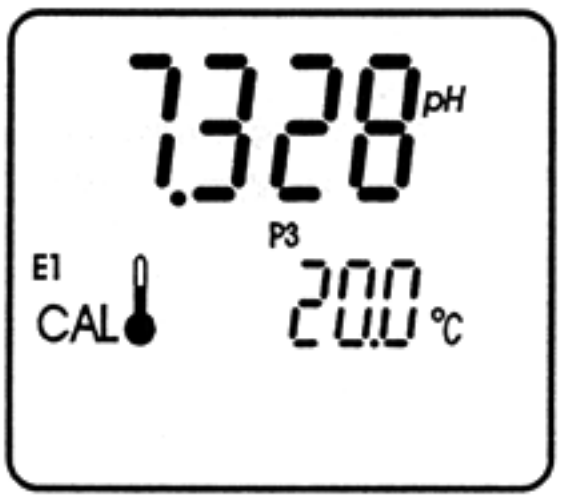
e. If the function of automatic change of the pH sample solution value is not used it is necessary to measure the temperature of sample solutions and bring it to the temperature given by the producer to receive the pH value identical like this entered to the meter's memory. There is no limitation in order of using the samples.

Under each of the electrode numbers it is possible to calibrate different electrode in sample solutions with different values (after entering those values to the meters memory).
If the pH sample solutions with values according to NIST are used the values should not be changed.
The meter takes under consideration only the values of sample solutions detected during calibration.

8.4.1. Calibration with automatic temperature compensation

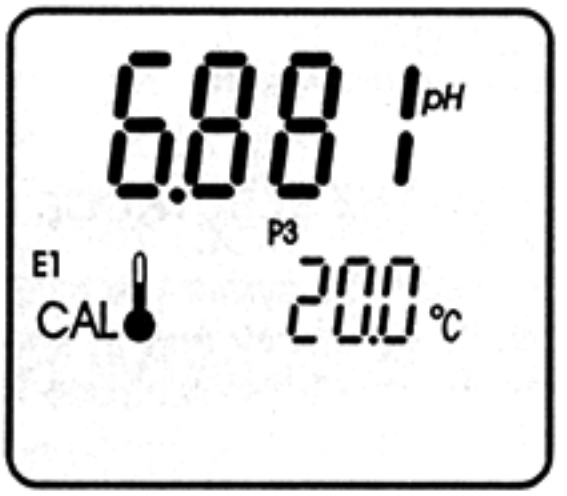
After preparing the meter to the calibration it is necessary in pH function to:

a. press and hold the CAL button till the appearance of the ***CAL*** *(pic. 7) symbol on the display;* ***the old parameters of calibration are deleted;***
b. put the electrode and the temperature probe to the buffer solution, a **P** symbol with number of calibration point will be displayed, wait till stabilisation of the result. The result may be different than pH value of the buffer solution (pic. 8).



Pic. 8.

After stabilisation of the result press the [CAL] button.
In this moment the result will blink what will inform about the storing the calibration result, in this same time in the upper row the corrected value of measurement will be displayed – it will be equal the value of used buffer solution (pic. 9).
If the function of automatic correction of the temperature influence on pH value of the buffer solution is used, this value will be considered in the displayed value of the buffer solution. If by accident someone will use buffer solution different than those set for the calibration the meter won't be able to detect this value and Err sign will be displayed. In this case it is necessary to check the value of the buffer solution or the electrode which may be broken or clogged.



Pic. 9.

c. one may finish the calibration at this moment by pressing the [pH] button or continue the calibration in other buffer solutions, washing the electrode and temperature probe before every immersing in the buffer and acting according to the point b.

After calibrating one electrode it is possible to calibrate two others, choosing the two remaining symbols according to point 6.3.

If after choosing the electrode number and entering the calibration mode one will exit it without making the calibration the earlier stored characteristic will be deleted and a standard characteristic will be adapted

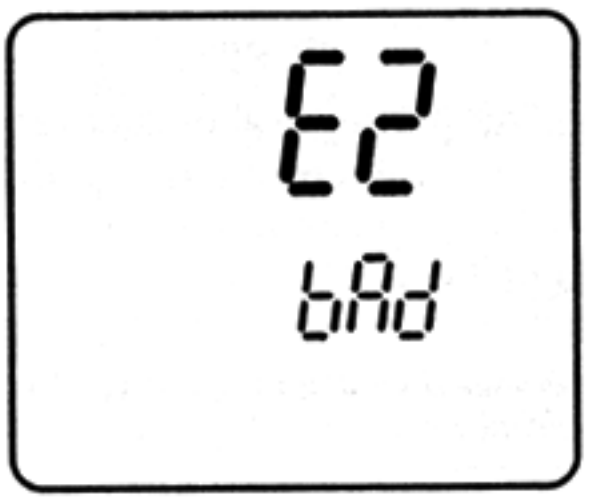
8.4.2 Calibration with manual temperature compensation

To start the calibration with manual temperature compensation one has to disconnect the temperature probe. Disconnecting the temperature probe switches the meter to manual compensation. On the display the entered value of the temperature is displayed, not the measured one. The ◄ , ► buttons will be unblocked and using them one may enter the value of the buffer solution temperature. This value is displayed in the lower row of numbers on the display.
Next thing is to join the pH electrode with the meter and act according to points a ÷ c. of the previous section. It is important to remember that in case of manual temperature compensation the temperature value entered by the user is taken under consideration.

Caution: simultaneous pressing of both ◄ and ► buttons sets the temperature to 20 ^{0}C.

9. CHECKING THE ELECTRODE CONDITION

If after the calibration the electrode symbol is blinking (E1, E2, E3) it informs that the electrode has lost its efficiency and in short time its calibration won't be possible. After entering the mode of electrode number changing under the number of electrode a bAd symbol will be displayed (pic. 10).
It is necessary to prepare a new electrode.



Pic. 10

10. pH MEASUREMENT

Before starting the measurement one has to prepare the meter for work (chapter 6) and pH electrode (chapter 7). Good condition of the electrode is the main condition of correct measurements. If the electrode was calibrated and is joined with the meter it is advisable to check whether the number of the electrode is this same as the number of the characteristic chosen from the memory. If not, the number should be changed according to section 6.3. and the resolution of measurement should be chosen according to the chapter 6.2.

10.1. Measurement with automatic temperature compensation

During measurements with automatic temperature compensation, the meter co-operates with the temperature probe and measures the temperature of the solution simultaneously with the pH measurement and takes it into consideration during compensation.
In case of measurement with automatic temperature compensation one should:

- join the temperature probe and the combination pH electrode to the right connectors on the meter **pH/mV/Ion** and **temp**, symbol 🌡 will be displayed;
- if the electrode wasn't calibrated or was already used for some time it is advisable to calibrate it. (chapter 8);
- insert the electrode and the temperature probe to the measured solution. During measurements in vessels one should not touch the bottom and the walls with the electrode. Best way is to use an electrode stand;
- Turn the meter on by pressing the ON/OFF button;
- using pH button choose the pH measurement function.
- After the stabilisation read the result

Accurate laboratory measurements require using of electromagnetic stirrer.

NOTICE: exceeding of the measuring range is indicated by blinking of the digits on the display. Exceeding the automatic temperature compensation range is signalised by blinking 🌡 symbol.

10.2. Measurements with manual temperature compensation

Disconnecting the temperature probe from the meter switches the meter to the manual temperature compensation mode (symbol  is displayed).
Measurement with manual temperature compensation is similar to the measurement with ATC, the difference is that using ◄, ► buttons one enters the temperature measured with other thermometer. This value is displayed under the pH value and is taken into consideration during the compensation.
The manual compensation may be used during stable conditions ex. during pH measurements in the laboratory, especially when a thermostat is used, or when the temperature probe was damaged.
During the measurement with manual temperature compensation one should:

- insert the pH electrode to the vessel with the measured solution, if the electrode wasn't calibrated or already was used for a long time the calibration should be done (chapter 8). During measurements in a vessel one shouldn't touch the bottom and the walls with the electrode. The best way is to use an electrode stand;
- using a laboratory thermometer measure the temperature;
- turn the meter on using the ON/OFF button;
- using the pH button choose the pH function;
- with ◄ ► buttons enter the value of measured temperature;
- wait till the stabilisation of the value and read the result.

Caution: simultaneous pressing of ◄ and ► buttons sets the temperature value to 20 ^{0}C.

11. NOTICES ABOUT THE TEMPERATURE COMPENSATION AND INTERPRETATION OF pH MEASUREMENT RESULTS

The pH meters **CP-501** and **CP-502** have a manual and automatic temperature compensation, which enables eliminating errors resulting from changes of the electrode characteristics under the influence of temperature changes. To explain the role of the temperature compensation it is important to remind that pH meter is an mV meter which displays voltage counted to pH unit. In constant temperature for one pH unit a constant mV value is changed. In temperature of 20 ^{0}C it is 58,168 mV. The value of mV on one pH unit **changes together with the temperature,** what is taken into consideration in the formula for "k coefficient" of the pH electrode.

k=0.198422 T

Taking this change into consideration during measurement is called temperature compensation, which is connected with change of the electrode efficiency and not with the change of the measured solution caused by temperature change.

Changes of the pH values of some solutions with the temperature are very small and others big ex. pure water.

When comparing solutions, which change their values together with the temperature change, it should be done in this same temperature.

Sometimes it happens that results of measurement in this same solution in stable temperature are different. When analysing such a situation it is important to take following factors into consideration:

- differences may occur because of poor quality electrode;
- The result was treated as stabilised to fast (medium class electrode needs about 40 seconds to full stabilisation);
- the measured solution may not be homogeneous and lack of magnetic stirrer doesn't allow for obtaining similar results;
- During measurements in sewage some chemical reactions, which change the result, may occur;

Very small differences may be caused by the meters accuracy. The **CP-501** and **CP-502** have accuracy ±0.002 pH, ±1 digit, what practically means that in extreme situation results of 2 measurements may differ for 0.005 pH and this will be an acceptable error, because 1 measurement will be made with 0.002 pH error and second with -0.002 pH. ±1 digit information explains difference caused by rounding up of the result on the last visible place on LCD (discretisation error).

If after making a two point calibration in pH buffers 7.00 pH and 4.00 pH (acidic conditions), the results are checked in 9.00 pH (alkali conditions),

in some cases the result may be 8.90 pH or 9.10 pH. This may occur when the electrode has unsymmetrical characteristic. Making a 3 point calibration with alkali, neutral and acidic buffers may prevent from such errors. Sometimes the measurement results are unstable, the quality of the electrode has the crucial influence. **In most cases the reason for slow drifting of the result, it's unstability or prolonging the time of stabilisation is the clogged junction, broken electrode or contaminated membrane.**
Often it happens when wrong kind of electrode was chosen for the kind of measured solution.
Leaving the electrode for few hours in the distilled water or placing it in water with detergent may eliminate this symptoms, especially if the measurements were done in solutions with deposits, fats or oils. The electrode which for a long time wasn't used may have the junction clogged by KCl crystals, what may be removed by placing the electrode in distilled water. Heavily contaminated electrode may be cleaned in chloroform and deposits of iron in 2N HCl. The electrode life may be prolonged by storing it in KCl solution. Depending on the kind of measured solution or substance proper kind of electrode should be chosen. They differ one from another with shape, membranes look, kind of junction and body. Using electrode not proper for the kind of measured solution may cause it's damaging and make the measurement impossible.

III. Ion selective measurements

12. NOTICES ABOUT ION SELECTIVE MEASUREMENTS

The ion selective electrode changes it's potential depending on the concentration (activity) of the individual ions in the solution. The main rule of the measurement is based on the linear dependence of the electrode potential from the logarithm of ion activity in the solution and is expressed by Nernst's equation:

$$E = E_o + 2.303\ RT/nF\ \log (a_j)$$

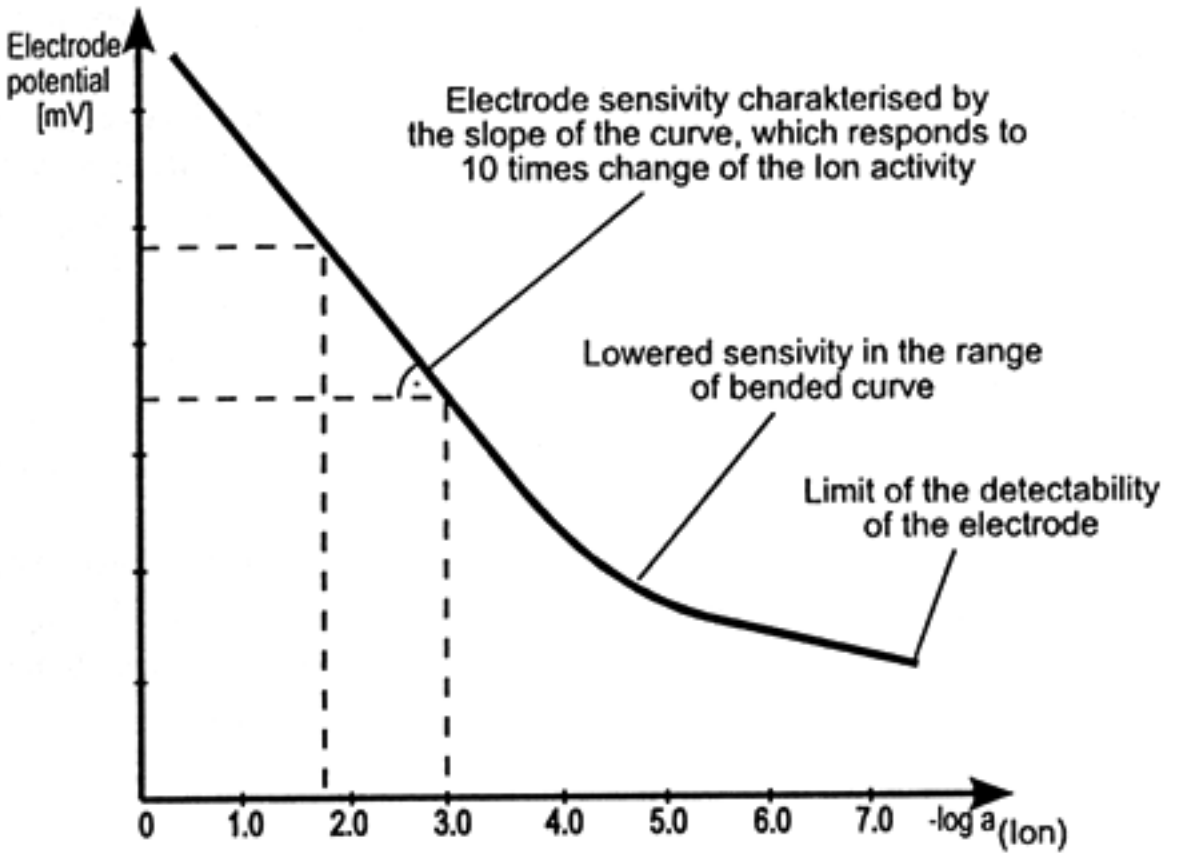
where:
- E - Electro Motoric Force of the measuring cell which consists of the ion selective and reference electrode in the measured solution (V)
- Eo - normal ion selective electrode potential, depends mainly on the internal electrolyte activity of the ion selective electrode and kind of reference electrode (V),
- ai - activity of the measured ion,
- n - valency of the measured ion,
- R - gas constant (8.31 J / K mol),
- T - temperature in K,
- F - Faraday's constant (96487 As/val)

The measurement of ion activity is based on measuring of the potential of ion selective electrode in relation with the reference electrode. In most cases this electrodes are in separate housings. The reference electrode should have an appropriate external electrolyte. This electrodes have a construction which enables replacing the electrolyte to the right one for the specific ion selective electrode. The electrode producers give information what electrolyte should be used depending on the measured ions.

Measured ion	External electrolyte
F^-, Cl^-, Br^-, J^-, S^{2-}, CN^-, Ag^+, Cu^{2+}, Cd^{2+}	1.0 M KNO_3
Ca^{2+}	1.0 M KNO_3 or 0.1 M KCl
NH_3	1.0 M KNO_3 or 0.1 M CH_3COOLi
K^+, Li^+	0.1 M NH_4NO_3
Na^+	0.1 M NH_4NO_3 or 0.1 M CH_3COOLi
NO_3^-	Saturated K_2SO_4

Table 5. The most often electrolytes.

The ion selective electrodes differ one from another with their characteristics. The typical shape of the characteristic of the ion selective electrode is showed on the picture 11.



Pic. 11

The best results may be achieved when the measurements are done in ranges that correspond with the linear parts of the characteristic. The essential electrode calibration on the sample solutions in that case may be done with larger difference of concentration of this solutions. The measurements made in ranges where the characteristic bends require choosing the sample solution which differ very little, because this lowers the electrode error. The measurements which are done in the ranges which correspond with lower part of the characteristic will have bigger and bigger errors, because of the lowering of electrode sensitivity. For the double valency ions the electrode sensitivity is twice lower than for single valency ions. Presence of other ions may have influence on the measurement result. The ions which interfere the electrode are given by it's producer, that's why by accurate measurements knowledge of the ion composition in the measured solution is important and it is necessary to act according to the hints which enable lowering the measurement error.

The condition of receiving accurate results is calibration and measurements in solutions with this same temperature. The best results are achieved in temperature close to 20 ^{o}C. High temperatures decrease the sensitivity and life time of the electrode. Large differences between the temperatures of calibration solutions and the measured samples, although using the temperature compensation, introduce error connected with lack of precisely determined isopotential point of the electrode.

Essential influence on the ion measurements has the pH value.

During accurate measurements the pH value of the measured sample should be identical with the pH value of the sample solutions. For each electrode a pH range is given in which it is working without interference.

Exact complying with the electrode producer's hints is the basic condition of success during measurements.
Preparation of the measured solution has a great influence on the final result. The fundamental meaning by the measurements of high concentration solutions has the phenomenon of ion activity changes together with change of their concentration, what may be described with the formula:

$$ai = fi \cdot ci$$

where: ai - ion activity in the solution,
fi - ion activity coefficient,
ci - ion concentration in the solution in mol/l or g/l.

Stabilisation of the ion activity in the high concentration solutions is the condition of proper measurement. Adding the stabilising factor, recommended by the electrode producer, enables linearisation of the electrode characteristic for this concentrations, increases it's sensitivity and enables for stable measurements.
Ageing of the electrode has an influence on the lowering the electrode sensitivity, prolonging the reaction time, shrinking the measuring range and increasing of the membrane resistivity

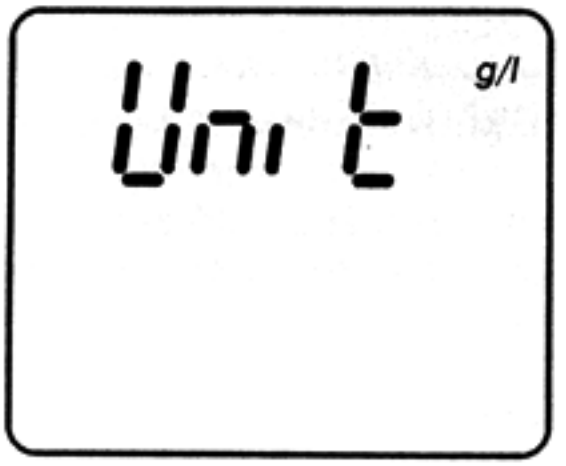
13. PREPARATION OF THE METER FOR WORK

Before the calibration it is necessary to make the activities described in the chapter 6. Additionally it is necessary to choose the unit in which we are going to make the calibration and measurement.

13.1. Choosing the unit

The result may be displayed in: **g/l. M/l ppm or pX**. To choose the unit:

- in the ion meter mode press and hold the MODE button till displaying in the upper row of LCD a Unit (unit) sign;
- with ↙ , ↗ buttons choose the unit displayed on the right side (pic. 12). In case of measurement in pX in the lower row a p symbol will be displayed.



Pic. 12.

- enter the measurement mode by pressing the Ion button.

14. ION SELECTIVE ELECTRODES CALIBRATION

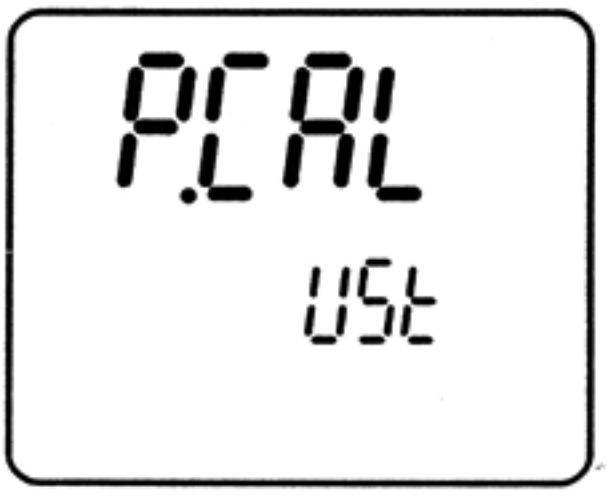
Because of the not linear characteristic of the ion selective electrodes, the values of sample solutions should be close to the forecasted value of the measured solution and the ratio of the concentration shouldn't be greater than 1:100. Usually in practice the prepared sample solutions have 1:10 ratio and by 3 point calibration 1:10. It is advised to prepare the sample solutions and measured solutions in this same volume. Differences in volume may have some influence on the result. The most accurate results are achieved in this same temperature in which the calibration was done. During calibration it is possible to choose the m mol weight of one of twenty ions stored in the memory of introduce mol weight and valency of ion which is not stored in the memory. It enables changing the unit in which the measurement is done for the calibrated ion (ex from g/l to M/l) and reading the result in new unit.

14.1. Entering the calibration parameters

The values of calibration points in ion meter are shared for all 3 characteristics of electrodes. After changing the ion the values of points entered in **g/l** or **ppm** will be counted to mol weight of the newly chosen ion. **It is very important to remember about the need of introducing the value of calibration points after changing the ion**

It is necessary to:

a. Enter the ion and values of the sample solutions used for calibration.
   To do so it is necessary to press the MODE button, in the upper row a PCAL (points of calibration) symbol will be displayed and in the lower row a USt (user settable value of the sample solution pic. 13);



Pic. 13.

b. Press the [CAL] Button in the upper row a ion symbol will be displayed and in the lower the number of ion. According to the table placed by the display on the meter (which is a shortened version of the below placed table) with [↙], [↗] buttons choose the number of ion according to used electrode:

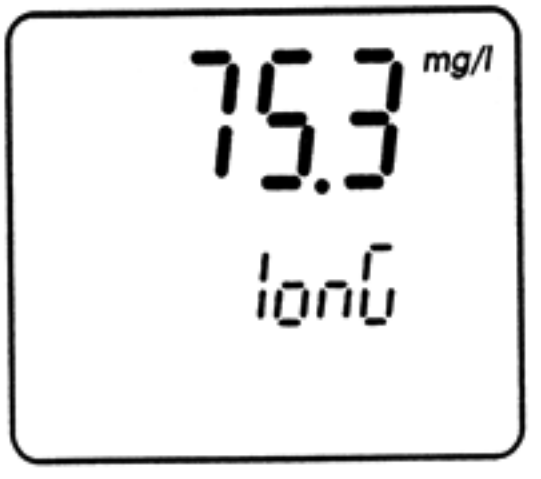
Table 6.

no	ion	Weight		ion	Weight
1	H^+	1.007	11	F^-	18.998
2	Ag^+	107.868	12	I^-	126.904
3	Br^-	79.904	13	K^+	39.098
4	BF^-_4	86.805	14	Li^+	6.941
5	Ca^{2+}	40.078	15	Na^+	22.990
6	Cd^{2+}	112.411	16	NH_4^+	18.038
7	Cl^-	35.453	17	NO_3^-	62.005
8	ClO_4^-	99.450	18	Pb^{2+}	207.200
9	CN^-	26.018	19	S^{2-}	32.066
10	Cu^{2+}	63.546	20	SCN^-	58.083

In case of measurement of ion which is not listed in the table one should:

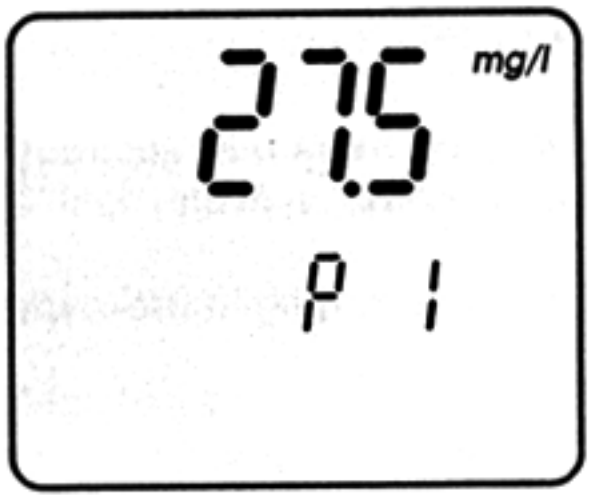
- press and hold the [↗] button till displaying in place of ion number a USEr (user) symbol.
- press the [CAL] button, in the lower row a IonC, symbol will be displayed and in the upper the last entered mol weight (pic. 14);
- with [↙] [↗] buttons enter the **mol weight** of the measured ion;
- press the [CAL] button in lower row a IonE symbol will be displayed and in upper the last entered valency;
- with [↙] [↗] buttons choose the right **valency** of the ion (2E-, E-, E, 2E);

By short pressing of the [CAL] button return to the ion choosing screen, or enter the measuring mode by pressing the chosen function button.
The entered mol weight and valency will be taken by the meter into consideration during all conversions.



Pic. 14.

c. Press the [CAL] button in the lower row a P1 (point 1) symbol will be displayed – first sample solution and in the upper one value of the sample solution (pic. 15). With [↙] [↗] buttons enter the value of sample solution used in this point.



Pic. 15.

To move to the second point of calibration introduction it is necessary to press the [CAL] button, in the lower row a P2 (point 2) symbol will be displayed and in the upper the stored value of sample solution for this point. It is possible to control or change the values of sample solutions in the rest of points as it was described above. After entering the last value of sample solution press the [MODE] button to return to PCAL mode or [ION] button to enter the measuring mode.

The values of sample solutions entered by user are stored till their changing to other.

During next calibrations, if the values of previously used sample solutions were not changed it is not necessary to make the actions described in this point.

Caution: the values of calibration points are stored in pX and than counted for displaying in the chosen unit. That's why during entering the small values in units different than pX the changes of values will be visible after pressing the [↙] [↗] buttons few times. Pressing and holding [↙] or [↗] button (repetition) eliminates this inconvenience.

14.2. Actions during calibration

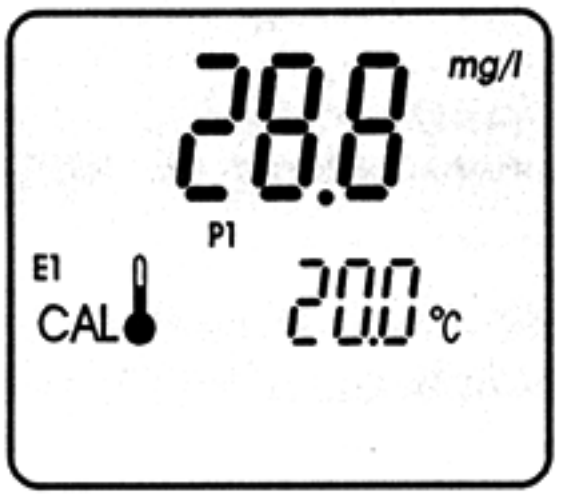
a. choose the electrode number under which the calibration will be stored (point 6.3;)
b. choose the unit in which the calibration will be done (point 13.1);
c. prepare the electrode to work according to the producer's instructions and mark it with number responding to number chosen in the meter (E 1, E2, E3).
d. connect with the meter the prepared electrodes: ion selective and reference and temperature probe, use the right connectors **pH/mV/Ion** and **temp;**
e. prepare the sample solutions according to the instructions of ion selective electrode producer.

Under each number next electrode in different sample solutions may be calibrated (after entering those values to the meter's memory).

14.3. Calibration with automatic temperature compensation

After preparing the meter to the calibration as it was described above it is necessary in pH function to:

a. press and hold the CAL button till the appearance of the *CAL* (pic. 16) symbol on the display; **the old parameters of calibration are deleted**. Between the upper and lower row of the display a P1 (point 1 of calibration) symbol will be displayed;



Pic. 16.

b. put the electrodes and the temperature probe to the buffer solution, wait till stabilisation of the result. The result may be different than the value of the sample solution. After stabilisation of the result press the CAL button. In this moment the result will blink what will inform about the storing the calibration result, in this same time in the upper row the corrected value of measurement will be displayed – it will be equal to the value of used sample solution. the P1 symbol will be changed to P2 (second calibration point)

c. continue the calibration in other buffer solutions, washing the electrodes and temperature probe before every immersing in the sample solution and acting according to the point b.

After calibrating one electrode it is possible to calibrate two others, choosing the two remaining symbols according to point 6.3.

If after choosing the electrode number and entering the calibration mode one will exit it without making the calibration the earlier stored characteristic will be deleted and a standard characteristic for the chosen ion will be adapted

14.4. Calibration with manual temperature compensation

To start the calibration with manual temperature compensation one has to disconnect the temperature probe. Disconnecting the temperature probe switches the meter to manual compensation. On the display the entered value of the temperature is displayed, not the measured one. The ↙ , ↗ buttons will be unblocked and using them one may enter the value of the sample solution temperature. This value is displayed in the lower row of numbers on the display.
Next thing is to join the ion selective electrode with the meter and act according to points a ÷ c. of the previous section. It is important to remember that in case of manual temperature compensation the temperature value entered by the user is taken under consideration.

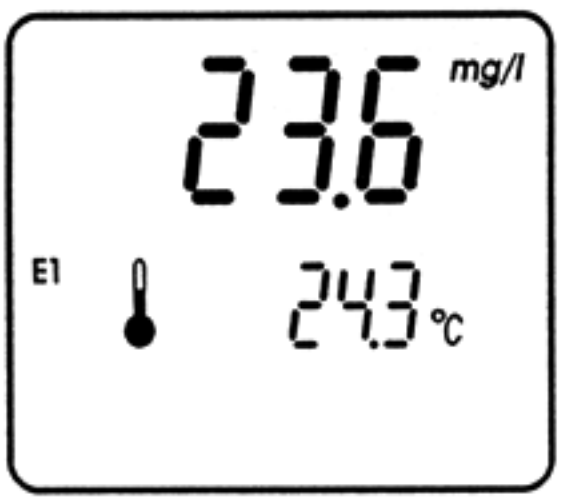
Caution: simultaneous pressing of both ↙ and ↗ buttons sets the temperature to 20 ^{0}C.

15. ION SELECTIVE MEASUREMENT

The ion selective measurement is made in mV (linear scale) with taking the temperature under consideration. After choosing the unit ***M/l*** or ***g/l*** the results in mV are converted and displayed in M/l or g/l (logarithmic scale).
During accurate measurements it is recommended to make the calibration and measurements in this same temperature. The meter may be set to manual temperature compensation and bring the temperature of the measured solution to temperature of the sample solutions. It is also possible to use the automatic temperature compensation but the above given recommendation should be obeyed.
The best measurement accuracy may be achieved if the measurements are done right after calibration. The calibration is essential.
Small changes of the result close to the measured value depend on the quality of used electrode.

15.1. Measurement with automatic temperature compensation

To make the measurement it is necessary to:
- join the temperature probe and the ion measuring and reference electrode to the right connectors (**pH/mV/Ion, Gnd** and **temp)**;
- choose the number of electrode under which it was calibrated (point 6.2.);
- choose the unit according to point 13.1;
- set the required resolution according to point 6.3;
- insert the electrodes and the temperature probe to the measured solution.
- bring the temperature of the measured solution to the sample solution temperature;
- make the measurement and after the stabilisation read the result



Pic. 17.

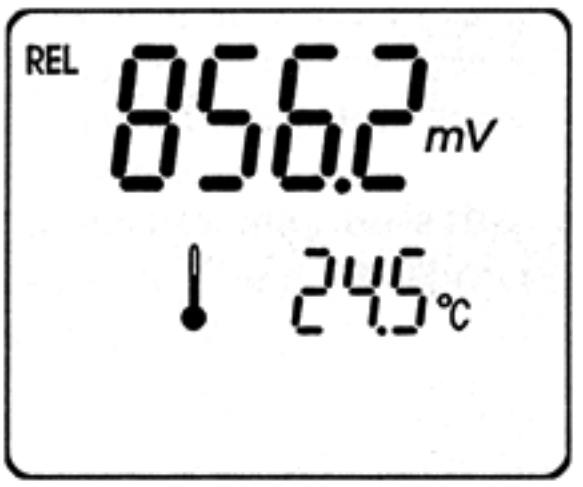
15.2. Measurement with manual temperature compensation

Act identically like in point 15.1, do not connect the temperature probe. Way of entering the temperature for manual compensation was described in point 8.4.2.

III. ORP (mV) and temperature measurement

16. ORP (VOLTAGE) MEASUREMENT

The pH / ion meters **CPI-501, CPI-502** are accurate mV meters (Oxidation Reduction Potential). The measurement may be done with special redox electrode or during titration. The result may be checked after choosing the mV mode with [mV] button and setting the required resolution point 6.2.



Pic. 18.

Short pressing of the [CAL] button causes taking the actually measured value as zero and entering the relative voltage measurement (in left upper corner of the LCD a REL symbol is displayed). Next pressing of the [CAL] button returns the meter to standard mV measurement (REL symbol disappears).

17. TEMPERATURE MEASUREMENT

The temperature measurement is done as follows:
- to the Chinch connector connect the temperature probe;
- by pressing the [ON/OFF] button switch the meter on;
- put the temperature probe to the measured solution;
- wait till the stabilisation of the value and read the lower row of numbers.

The meter co-operates with the PT-1000 probe. Depending on it's class the accuracy of the measurement changes.

NOTICE: break in the circuit of the temperature probe switches the meter to the manual temperature compensation mode. It is signalised by changing the symbol to symbol. On the display in place of the measured temperature value the value of the temperature entered by the user is displayed.
Blinking -50°C value during measurement in positive temperatures informs about short circuit in the temperature probe..

V. Other

18. CLOCK WITH DATE,

After choosing the **time** mode with [time] button the meter will display the actual time. By pressing the [MODE] button one may display the date and the meter's software version.

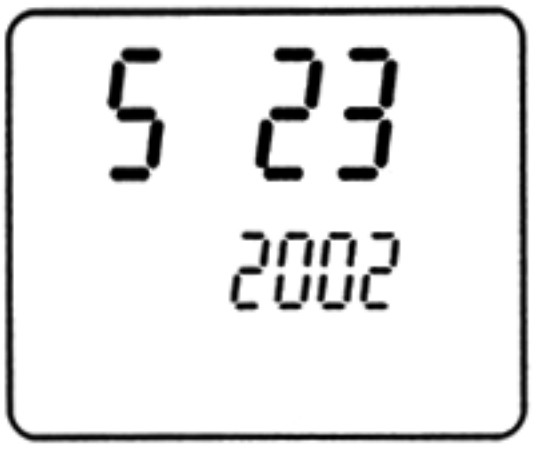
18.1. Time display

The hour is displayed in two rows. In the upper one the hour and minutes are displayed and in the lower one seconds. The way of changing the hours is described in the chapter 18.3.

Pic. 19

18.2. Date display

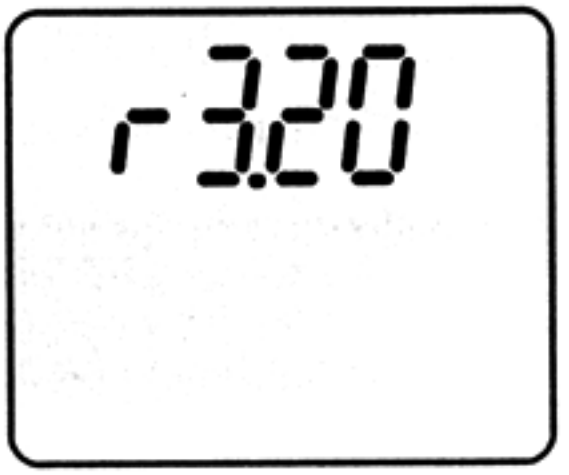
The date is displayed as follows: Month – Day – Year. (pic. 20) In the upper row the month and day are displayed and in the lower the year.



Pic. 20.

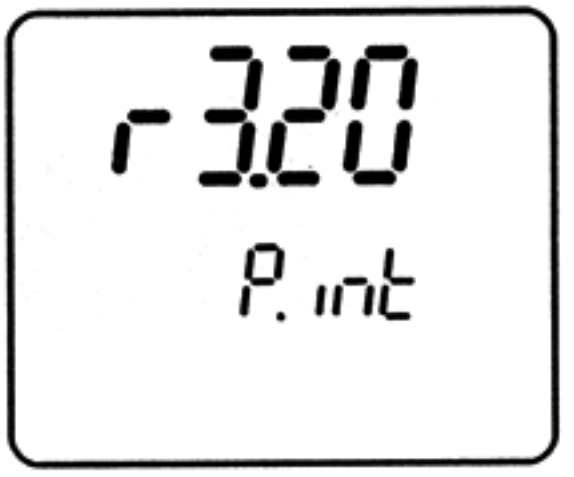
18.3. Readout of the meter's software version

In the **time** function press the [MODE] button till displaying a screen, as on the picture 21 for **CPI-501**, or on the picture 22 for the **CPI-502**. In the upper row the software version is displayed.



Pic. 21.

In case of the **CPI-502** meter additionally in the lower row of display a P. int sign will be displayed, what informs that the internal printer is installed.

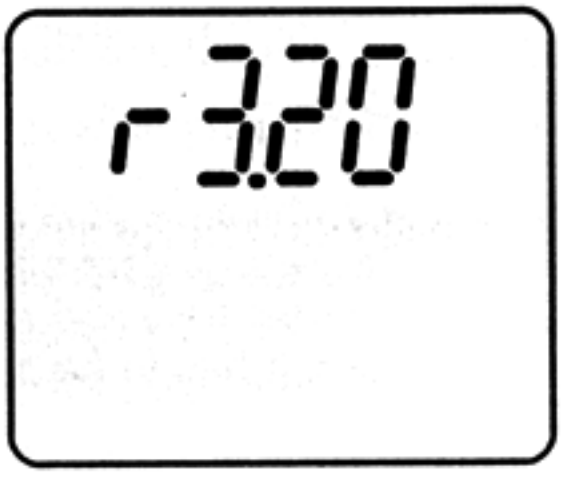


Pic. 22.

By pressing the [time] button one returns to the **time** mode.

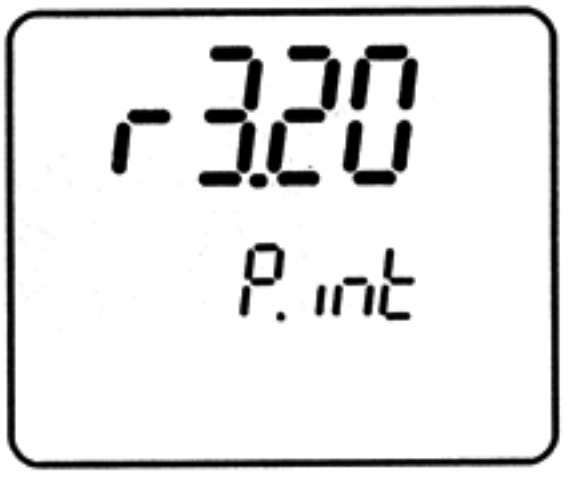
18.3. Readout of the meter's software version

In the **time** function press the MODE button till displaying a screen, as on the picture 21 for **CPI-501**, or on the picture 22 for the **CPI-502**. In the upper row the software version is displayed.



Pic. 21.

In case of the **CPI-502** meter additionally in the lower row of display a P. int sign will be displayed, what informs that the internal printer is installed.



Pic. 22.

By pressing the time button one returns to the **time** mode.

18.4. Setting the time and date

The setting mode of the actually displayed parameter one enters by pressing and holding the [CAL] button. The position which we are going to change starts blinking, the value is changed with [◄] or [►] buttons. The pulsating position is chosen by short pressing of the [CAL] button. There is no way to set the seconds, they are deleted after pressing any of the function buttons.
After pressing the [time] button the setting mode is being left.

The clock is powered by lithium battery which life time is approximated to 10 years. Blinking time, after switching the meter, informs about loosing the time settings and requires introducing the correct time and date. If the situation is repeated after each turning the meter on it has to be sent to our service for replacing the battery.

19. STORAGE AND RED OUT OF THE RESULTS

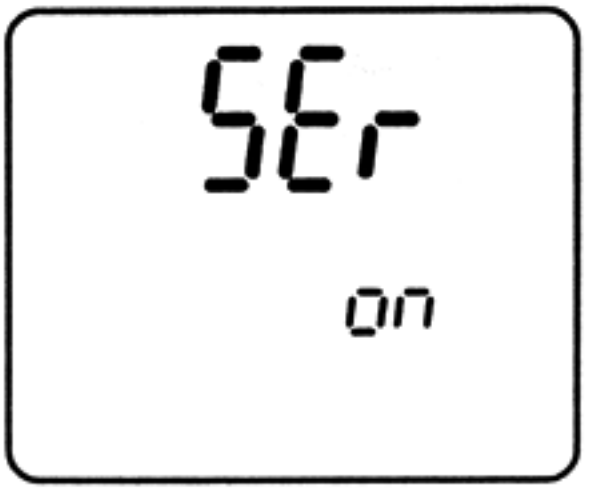
19.1. Storing or printing

The meter enables storing, readout or printing of actually measured function results. The results are stored in EEPROM memory, which is non-volatile, so the data isn't lost even after complete lack of power. There is also possibility to printout on request the result of measurement which is being done at this moment or results which are stored in the memory. Before starting the work it is necessary to choose the storing or printing function and determine the way of displaying the result.

19.2. Parameters of storing and reading from the memory

The parameters are changed in the readout mode. It may be entered from every measuring function by pressing and holding the MEM PRINT button, until on the display the number of last stored result will be displayed. This number is displayed on turns with the stored result.
Before starting the storing one has to choose the kind of results collecting: on request or as series, and also the way of displaying the result.
Next pressing of the MODE button shows screens with following functions which may be changed:

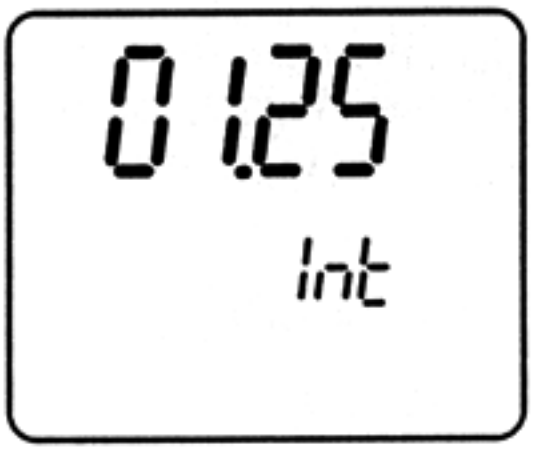
SEr - taking or printing series or single results. (pic. 23)



Pic. 23.

With ◄ or ► button choose in lower row on or oFF symbols (pic. 23). Choosing on activates automatic storing of the results and oFF single, after every pressing of MEM/PRINT. button

b. Int - time interval during series taking (pic.24).



Pic. 24.

Value of the time interval is displayed in the lower row of digits, and the informative symbol Int in the upper row. It is necessary with use of the ◄ and ► buttons to set the chosen time in minutes and seconds. The shortest time is 2 seconds and the longest 60 minutes. Holding the buttons make changing quicker. (repetition). In case of choosing the SEr parameter to oFF the position Int isn't displayed.

c. Prt - printing - yes or no. With ◄ ► buttons one has to choose on when the results should be sent to the output set as the Out parameter, or oFF, when they should be stored in the memory.

d. Out (output) sending the result to outputs chosen with ◄ ► buttons.
   - PC - output for PC by **RS-232**,
   - CEn - output for external printer by **Centronics**;
   - Int - output for internal printer (only in **CPI-502**).

e. ALL - Way of displaying the stored results.

   on - successively number of sample, result, time and date of storing the result.
   oFF - successively number of sample and result

   Changing with ◄ ► buttons.

Return to the results readout display after pressing MEM/PRINT button.

Exit from the readout mode after pressing any of the function buttons.

19.3. Storing the single measurements in the memory

If according to previous section storing of single results was chosen and that the results will be collected in the memory and not printed or sent to a PC every pressing of MEM PRINT button stores the measured result. The results are stored as the next ones after the last stored. If someone was checking the earlier stored results and didn't return to the last one the results won't be deleted and the value will be stored after the last measurement. If the user wants to store the result from the chosen number first he has to delete the results (as described in the point 19.6) and next start storing the results by pressing the MEM PRINT button.
During storing the results the number of result will be displayed for a moment.
If after pressing the MEM PRINT button instead of number an End sign will be displayed it informs that the maximal number of results was stored.

19.4. Storing the measuring series

There is possibility to store series of measurements, to do so one has to :
choose the way of collecting the measurements (p. 19.2a);
enter the time interval (p. 19.2b)
delete the stored results starting from the chosen one (p. 19.6);
with the proper button choose the function which results one wants to store
with MEM PRINT button start taking the series. The measurements will be stored starting from the first free number.

Taking the series is signalised by blinking LED diode in the MEM PRINT button.
Before each storing of the result the number of measurement will be displayed for a moment. Taking of the series may be stopped by pressing MEM PRINT button, any of the function buttons or by filling the memory. If taking the series was stopped earlier than the memory was filled one may start to take the next series till the end of memory

19.5. Reviewing of the results

Reviewing of the stored results is started from the measuring mode, by pressing and holding the MEM/PRINT button until the number of last stored result on turns with it's value will be showed.
Every pressing of the ↙ or ↗ button shows the next or previous number and result with time and date if ALL **function was chosen** (p. 19.2.e.).
In this mode the buttons ↙, ↗ work with repetition and after longer holding the numbers change very quickly till stopping on the highest or lowest number.
The reviewing mode may be left by pressing any of the function buttons.

19.6. Deleting the stored results

To delete the stored results one has to:

- press and hold the MEM/PRINT button;
- with buttons ↙ or ↗ set the number of measurement from which we want do delete the memory;
- press and hold the CAL button what will delete the stored results from the chosen one till the end of the memory, till on the display in the place of results there will be --- sign displayed what confirms the deleting.
- The reviewing mode may be left by pressing any of the function buttons.

In case of using all numbers of memory more results won't be stored. To store new results it is necessary to delete the old ones acting as it was described above.
If one wants to clear all the memory the deleting should be started from the first number.

20. PRINTOUTS ON THE PRINTERS

In the right wall of the meter there is a Centronics output which enables joining the meter with printer using standard cable. In the **CP-502** the results may be also printed on the internal printer.
There is possibility to print the measured value, or the results stored in the memory.

20.1. Choosing the direction of sending the data

Before sending the current results or those stored to the printer or PC it is necessary, in the readout mode press the [MODE] button till appearing in the upper row of LCD an Out (output) symbol, and next with [◄], [►] buttons choose in the lower row one of the symbols:

- PC - output for PC by **RS-232**,
- Cen - output for external printer by **Centronics**;
- Int - output for internal printer (only **CPI-502**).

20.2. Printout of the result – single or serial

To print the result of the current measurement one should:

- connect the printer with the meter;
- switch the meter and the printer on;
- choose the direction of sending the data (chapter 20.1);
- set the printout parameter Prt to on (chapter 19.2.c);
- choose the printout form (chapter 19.2.e) and way of printing – single or serial printouts (chapter 19.2.a);
- if the single kind of taking measurements was chosen, every pressing of the [MEM/PRINT] button will cause printing the actually measured value temperature and number;
- if taking the series of measurements was chosen, after pressing the [MEM/PRINT] button printing of actually measured value, temperature and number of measurement with chosen time interval will be started.

If the parameter ALL was set to on together with the value of actually measured result and temperature the date and hour will be printed.

Printing of the series may be stopped by pressing the [MEM/PRINT] button or any of the function buttons.
There are no limits in number of printed results.

20.3. Printout of the results stored in the memory

To print the results stored in the memory:
- join the printer with the meter using the cable (optionally);
- switch the meter and printer on;
- choose the direction of sending the data (chapter 20.1);
- choose the printout format (point 19.2.e) and way of printing – serial or single (point 19.2.a)
- enter the results viewing mode (point 19.5), with buttons ◄, ► set the number of measurement from which the printing should be started. Pressing the MEM/PRINT.starts printing.

The results of measurements with numbers will be printed.
In case of setting the SEr parameter to on all results from the set one to the end of memory will be printed, in case of setting the SEr parameter to oFF only the result stored under the chosen number will be printed.
In case of setting the ALL parameter to on, together with the result of measured function and temperature the hour and date will be printed.

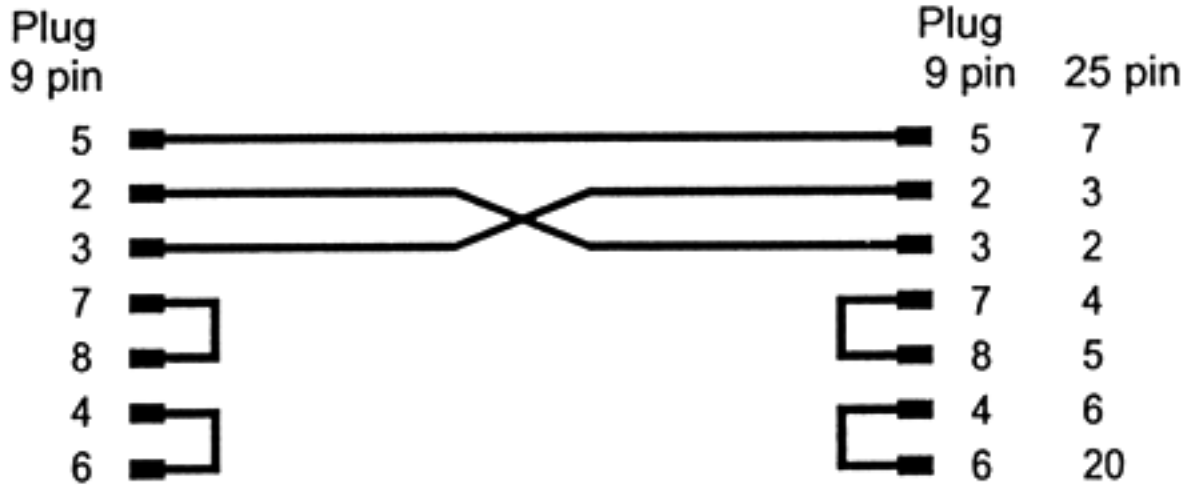
20.4. Internal printer maintenance in CPI-502

The printer maintenance basically is based on installing the paper. To do this one should:
- change the direction of sending the data to Int (point 20.1);
- move up the lever on the right side of the meter;
- into the slot on the back of the meter insert an evenly cut paper simultaneously pressing the LINE FEED button, till the end of paper will appear in the upper slot of the meter;
- move down the lever, the LED diode on the LINE FEED button will light what confirms the readiness of printer to work;
- Through the roll of paper put the handle and the bonded part place in the slot on the back of the meter and press it down.

The paper will move out, by one line, after each pressing of the LINE FEED button. Holding the LINE FEED button causes continuous moving out of the paper. The excess of the paper may by tear off on the notched edge of the slot.
In case of not using the printer for a longer time or using standard PC printer it is necessary to **move up the lever and leave it in this position**. The LED on the LINE FEED button will go out, what confirms switching the printer to stand by mode. End of the paper and improper lever position is signalised by blinking LED on the LINE FEED button.

21. CO-OPERATION WITH THE PC

Connecting the meter with a PC enables storing data directly on the computer, what eliminates the limitation to the memory capacity. The PC should be equipped with serial RS-232 connector (typically COM2) configured for 9600 b/s, 8 bit, 1 even bit, 1 stop bit, lack of steering the transmission.
On the picture 25 there is the way of joining the meter with the computer showed. On the right side of the picture there is the way of joining the cables with the 9 or 25 pin plug with relevant pin numbers.
For the transmission a special software prepared by our company may be ordered or residential Windows program - HyperTerminal (in menu Accessories / Communication). If it isn't there it should be installed from the Windows installation CD. The program should be configured with option „direct connection with port....COMx".
In the right wall of the meter there is a RS connector which enables joining the meter with a PC by a cable.



Pic. 25.

After connecting one should switch the meter and PC on and enter the results readout mode by longer pressing of the MEM/PRINT button, next press the MODE button till displaying in the upper row of LCD a Out (output) sign and with ◄, ► buttons chose in the lower row of LCD a PC symbol output for PC by RS-232C,
After pressing the MEM/PRINT button transmission of the current result and temperature will start. The mode and format of transmitted data depends on the set SEr, Int and ALL parameters.

The picture 25 shows way of connecting the meter with a PC. On the right side of picture the connections from the PC side are showed for 9 or 25 pin connector.

Caution: the meter and PC should be switched on after connecting the cable to both of them.

22. TECHNICAL DATA

pH MEASUREMENT:

range	resolution	Accuracy (±1digit)
-2.000 ÷ 16.000 pH	0.001 / 0.01 pH	±0.002 pH

INPUT IMPEDANCE: $10^{12}\ \Omega$
TEMPERATURE COMPENSATION: manual/automatic
RANGE OF COMPENSATION: -5.0 ÷ 110.0 °C
CALIBRATION OF THE pH ELECTRODE: automatic, in 1 ÷ 5 points

RANGE OF RECOGNITION AND ENTERING OF THE pH BUFFER SOLUTIONS

Calibration point	Range
1	0,800 ÷ 2,100
2	3,900 ÷ 4,100
3	6,800 ÷ 7,100
4	8,900 ÷ 10,200
5	11,800÷ 14,000

AUTOMATIC CHANGE OF THE pH BUFFER VALUE TOGETHER WITH THE TEMPERATURE CHANGE, FOR SAMPLES CONSISTENT WITH NIST, TABLE (page 19) IN RANGE: 0 ÷ 60 °C
THERMAL STABILITY OF ZERO: 0.0005 pH/ °C

ION SELECTIVE MEASUREMENT:

Range	Resolution	Accuracy (±1 digit)
-2.000 ÷ 16.000 pX	0.001 / 0.01 pX	±0.002 pX
0 ÷ 100 M/l	0.01 / 0.1 %	±0.25 %
0 ÷ 1 000 g/l	0.01 / 0.1 %	±0.25 %
0 ÷ 1 000 000 ppm	0.01 / 0.1 %	±0.25 %

INPUT IMPEDANCE: $10^{12}\ \Omega$
TEMPERATURE COMPENSATION: manual/automatic
RANGE OF COMPENSATION: -5.0 ÷ 110.0 °C
CALIBRATION OF THE ELECTRODE: in 1 ÷ 5 points

mV (ORP) MEASUREMENT:

range	resolution	Accuracy (±1 digit)
-1000 ÷ 1000 mV	0.1 mV	±0.1 mV

INPUT IMPEDANCE: $10^{12}\ \Omega$

TEMPERATURE MEASUREMENT:

Range	Resolution	Accuracy* (±1 digit)
- 50.0 ÷ 199.9 °C	0.1 °C	±0.1 °C

* accuracy of the meter. Final accuracy of the measurement depends on the accuracy of the used PT-1000 probe

TEMPERATURE PROBE: platinum resistor Pt-1000

ACCURACY OF THE PROBE IN RANGE: 0 ÷ 100 °C:
FOR PT1000B RESISTOR: ±0.8 °C
FOR PT1000 $^{1}/_{3}$B RESISTOR: ±0.27 °C

MEMORY OF THE RESULTS

Standard: 200 results
Optionally: 450 or 950 results
(when ordering the meter)

INTERNAL PRINTER (only CPI-502):

MECHANISM: LTP1245M
PAPER WIDTH : 60 mm
RESOLUTION: 384 pts/line
PRINTING DENSITY: 23 symbols/line

OTHER:

WORKING TEMPERATURE: 0 - 40 °C
POWER: stabilised power adapter
CPI-501 - 12V/100mA, **CPI-502** - 6V/2A.
POWER CONSUMPTION: 60 mW
SCREEN: LCD 55 x 45 mm
DIMENSIONS: 200 x 180 x 50 mm
WEIGHT: **CPI-501** – 650g, **CPI-502** - 720 g

23. EQUIPMENT

The standard equipment of the meter is:

1. Temperature probe Pt-1000B (standard);
2. Combination pH glass electrode
3. Power adapter: **CPI-501** 12V/100mA, **CPI-502** 6V/2A;
4. User's manual with warranty.

The additional equipment available for this meter is:

1. Combined pH electrode for measurements in sewage or liquids with deposits;
2. Ion selective electrode chosen from the price list;
3. Reference electrode for ion selective measurements;
4. 5XX-PC cable;
5. Software for collecting large number of data on the PC;
6. Temperature probe Pt-1000 1/3Bwith higher accuracy;
7. ORP measuring electrodes;
8. Electrodes for ORP (redox) measurement.